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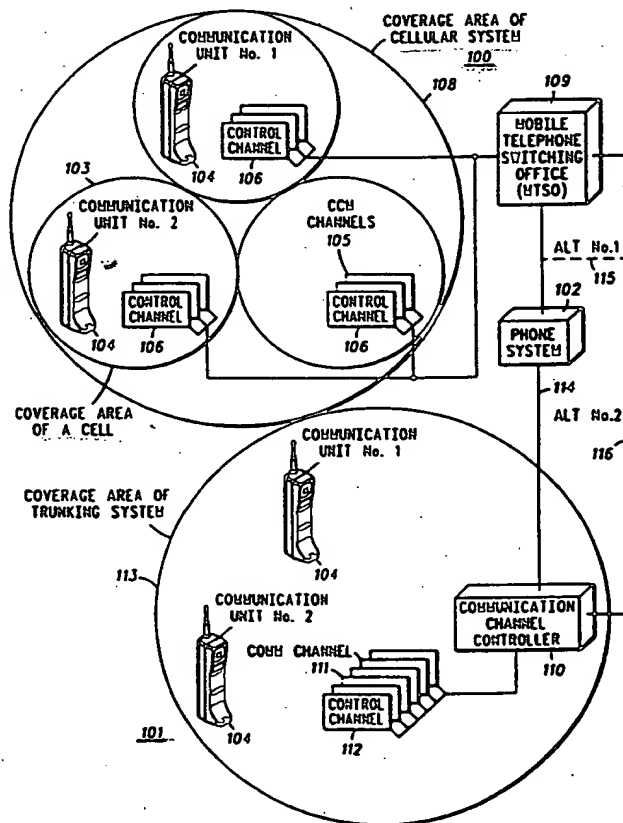
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(54) Title: PRIVATE DATA TRANSMISSION IN A MULTI MODE COMMUNICATION SYSTEM

(57) Abstract

In a geographic region that contains a trunking communication system (101) and a cellular communication system (100), wherein the coverage area (108, 113) of each system substantially overlaps, a method that transfers a private data transmission from the trunking communication system (101) to the cellular communication (100) is disclosed. When a data transmission unit (104) is prompted to transmit data, it transfers its affiliation from the trunking communication system (101) to the cellular communication system (100). Once affiliated with the cellular communication system (100), the data transmission unit (104) transfers data via the cellular communication system (100). The trunking communication system (101) detects the requested data and routes the requested data to the appropriate data target (104, 110). Once the data transmission unit (104) has transmitted the requested data, it transfers its affiliation back to trunking communication system (101).



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Private Data Transmission In A Multi Mode
Communication System

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Field of the Invention

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This invention relates generally to communication systems and in particular to a method that allows a trunking communication system to utilize a cellular communication system to privately transmit data.

Background of the Invention

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The basic operation and structure of trunking communication systems and cellular telephone communication systems (cellular communication systems) are known. Trunking communication systems typically comprise a communication channel controller, a limited number of repeaters that transceive information via communication channels, and a plurality of communication units which may be mobile vehicle radios and/or portable radios, and may also include data transmission features. Of the communication channels, one is typically chosen to be a control channel. The control channel typically transceives operational information between the communication channel controller and the data transmission features of the plurality of communication units such that, for example, the plurality of communication units can access the communication channels. Typically, the trunking system has a

relatively large geographic coverage area, depending on the environment that the trunking communication system is located, for example, the coverage area may be approximately thirty-five miles in diameter.

5 A cellular communication system typically comprises a mobile telephone switching office (MTSO), a plurality of cells, a limited number of communication channels, and a plurality of communication units which may be cellular telephones. Each of the plurality of cells
10 comprises some of the limited number of communication channels, wherein one of the communication channels is designated as the control channel for that cell. The control channel transceives operational information between the plurality of communication units within the
15 cell and the MTSO such that the communication units can place telephone calls via a phone system. Typically, the coverage area of each cell is relatively small in comparison with that of a typical trunking communication system. For example, a typical cell coverage area is
20 approximately two miles in diameter. Because an individual cell coverage area is relatively small, the communication channels maybe be reused, at least once, within a geographic region of approximately the same size as a trunking communication system.

25 In trunking communication systems, data may be transmitted, on the control channel, from the communication channel controller to the plurality of communication units. Such data transmissions cause data
30 traffic on the control channel and in many instances reduce the overall efficiency of the trunking communication system. For example, during a dynamic regrouping of communication units, each communication unit must be addressed individually due to unique

features of the communication unit. (Unique features of a communication unit may include priority calling, secure calling, private calling, etc.) Dynamic regrouping for large groups -of fifty communication units or more- typically requires a substantial amount of time -at least several seconds- to regroup the communication units.

In addition to receiving data from the communication channel controller, each of the plurality of communication units may individually transmit data to the communication channel controller. Data transmissions from a communication unit to the communication channel controller is also transmitted on the control channel of the trunking communication system which further adds to the data traffic. Such point to point data transmissions in the trunking communication system are relatively inefficient due to the limited number of communication channels used as control channels. (Typically, only one communication channel is designated as a control channel, thus all data transceived within the trunking communication system must be transceived over that control channel.) Cellular communication systems, however, are relatively efficient at processing point to point data transmissions due to the relatively large number of control channels; at least one for each cell of the cellular communication system where data transmissions in the cellular communication system include, for example, placing telephone calls.

Therefore, a need exists for a method that allows a trunking communication system to take advantage of the communication channel efficiency of a cellular communication system for point to point, or private, data transmissions.

Summary of the Invention

This need and others are substantially met by the private data transmission in a multi-mode communication system disclosed herein. In a geographic region that contains a trunking communication system and a cellular communication system, wherein the trunking communication and the cellular communication system have substantially overlapping coverage areas, wherein the trunking communication system is operably coupled to the cellular communication system, and wherein some data transmission units are affiliated with the trunking communication system and are operably in either the trunking communication system or the cellular communication system, a method for a data transmission unit to communicate data with a data target is presented. The method comprises the steps of receiving a data transmission request, which may be internally generated within the data transmission unit or received from a communication channel controller. After receiving the data transmission request, the data transmission unit transfers its affiliation from the trunking communication system to the cellular communication system. Once affiliated with the cellular communication system, the data transmission unit transmits the requested data information to a designated data target via the cellular communication system.

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Brief Description of the Drawings

FIG. 1 illustrates a cellular communication system and a trunking communication system each having

substantially the same coverage areas in accordance with the present invention.

FIG. 2 illustrates a logic diagram that may be used to implement the present invention.

Description of a Preferred Embodiment

FIG. 1 illustrates a trunking communication system 101 and a cellular communication system 100 operably coupled together in accordance with the present invention. The cellular communication system comprises a mobile telephone switching office (MTSO) 109 and a plurality of cells 103 (3 shown), where each cell is operably coupled to the MTSO 109 and has a specific coverage area 107. Each cell comprises a limited number of communication channels 105 which may be carrier frequencies, frequency pairs, and/or time division multiplexing (TDM) slots, wherein one of the communication channels is designated as a control channel. The summation of the coverage area of each cell 107 comprises the coverage area of the cellular communication system 108. The cellular communication system also comprises a plurality of communication units 104 (2 shown) where the communication units are equipped with one receiver and one transmitter that has adequate bandwidth to operate in both the trunking communication system and the cellular communication system.

The trunking communication system 101 comprises a communication channel controller 110, a plurality of communication channels 111, wherein one of the communication channels is designated as a control channel 112, and a plurality of communication units 104.

The coverage area of the trunking communication system 113 substantially overlaps and may be approximately equal to, the coverage area of the cellular communication system 108. However, for illustrative purposes the coverage areas are shown separately.

The trunking communication system 101 is operably coupled to the cellular communication system by one of three methods. The first and most convenient method, especially when the communication systems are manufactured by different manufacturers, is to couple the systems together through a phone line 114 or a plurality of phone lines to a phone system 102. This coupling method allows the trunking communication system to transfer messages to the cellular communication system by placing telephone calls to the cellular communication system via the telephone system 102. An alternative method is to directly connect the communication channel controller 110 to the MTSO 109 by a direct connection 116. Finally, if the communication systems are manufactured by the same manufacturer, or an agreement exists between the manufacturers, the communication channel controller 110 may be directly coupled into the communication channel links 117 of the cellular communication system by a coupling link 115 that is similar to a telephone link.

Generally, in accordance with the present invention, data transmission units are affiliated with the trunking communication system by monitoring the trunking communication system's control channel. When a particular data transmission unit is prompted to transmit data, it transfers its affiliation from the trunking communication system to the cellular

communication system. Once the particular data transmission unit is affiliated with the cellular communication system, the requested data is transmitted via the cellular communication system. The trunking communication system, through a phone connection to the cellular communication system, receives the requested data information and deciphers it to determine the data target. The requested data information is then routed, by the communication channel controller, to the data target. Once the particular data transmission unit has transmitted the requested data information, it transfers its affiliation back to the trunking communication system. Note that a data transmission unit may be a communication unit that acts as a trunking communication radio that transceives both voice and data while affiliated with the trunking communication system and acts as a cellular telephone that transceives both voice and data while affiliated with the cellular communication system.

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FIG. 2 illustrates a logic diagram of the present invention. At step 200, a data transmission unit is prompted with a data transmission request. The prompting of the data transmission unit may be done by a user of the data transmission unit wherein the user desires to transmit data either to another data transmission unit or to the communication channel controller. The prompting may also be initiated by the communication channel controller, wherein the communication channel controller requests the data transmission unit to transmit data information or desires to send data to the data transmission unit. If the data transmission unit did not receive the data transmission request 201, either due to the data

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transmission being off or out of range, the process ends.

5 If the data transmission unit received the data transmission request 201, the data transmission unit transfers its affiliation from the trunking communication system to the cellular communication system 202. Transferring affiliation from the trunking communication system to the cellular communication system may be accomplished by changing a local oscillator of a receiver and a transmitter of the data transmission unit such that the data transmission unit is operable in the cellular transmit and receive areas as opposed to the trunking transmit and receive bands. 10 Transferring affiliation back to the trunking communication system is accomplished in a similar manner except that the local oscillator is adjusted such that the data transmission unit is operable in the trunking transmit and receive bands. 15

20 Once the data transmission unit is affiliated with the cellular communication system, the communication channel controller, via the interconnection to the cellular communication system, transmits the remainder of the data transmission request 203. The remainder of the data transmission request may be a telephone number that, in addition to identifying the particular data transmission unit, contains data or a request for specific data transmissions. For example, three digits 25 of the telephone number may indicate a talk group assignment for the data transmission unit, such that the data transmission unit automatically changes its talk group affiliation when the telephone number is detected. Another example may be that the telephone number 30

requests the data transmission unit to transmit data relating to its on air time.

After receiving the remainder of the data
5 transmission request, the data transmission unit performs the requested operation 204. If the requested operation is to transmit data to a data target, the data transmission unit places a telephone call, via the
10 cellular communication system, to the trunking communication system, wherein the requested data is contained within the digits of the telephone number. The trunking communication system deciphers the transmitted data and routes at least a representation of the data to the data target. A data target may be
15 another data transmission unit, the communication channel controller, a console of the trunking communication system, or a particular data acquisition device such as a data recorder that may be used to record on air time to determine charges, etc. Once the
20 requested data has been transmitted by the data transmission unit, it transfers its affiliation back to the trunking communication system 205 and the process ends.

25 If the data transmission unit prompted the data transmission request 200, it transfers its affiliation to the cellular communication system. Once affiliated with the cellular communication system, the data transmission unit places a telephone call to the
30 trunking communication system via the cellular communication system 204. The communication channel controller receives and deciphers the telephone call to extract the data and the data target, if one is included. If the data was intended for a data target,

the communication channel controller routes the data to the data target. Once the data transmission unit has transmitted the data, it transfers its affiliation back to the cellular communication system 205.

Claims

1. In a geographic region that contains at least one trunking communication system and at least one cellular communication system, wherein the at least one trunking communication system and the at least one cellular communication system have substantially overlapping coverage areas, wherein the at least one trunking communication system is operably coupled to the at least one cellular communication system, and wherein at least some of a plurality of data transmission units are affiliated with the at least one trunking communication system and are operable in either the at least one trunking communication system or the at least one cellular communication system, a method for a data transmission unit of the at least some of the plurality of data transmission units to communicate data with a data target, the method comprises the steps of:
- a) transferring affiliation of the data transmission unit from the at least one trunking communication system to the at least one cellular communication system; and
 - b) transmitting a data packet by the data transmission unit via the at least one cellular communication system.

2. The method of claim 1 further comprises the step of transferring affiliation of the data transmission unit from the at least one cellular communication system to the at least one trunking communication unit when the data packet has been transmitted.

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3. In the method of claim 1, step (a) further comprises the substep of:

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a1) prompting, by a communication channel controller of the at least one trunking communication system, the data transmission unit to transfer its affiliation to the at least one cellular communication system; and

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a2) transferring, by the data transmission unit, its affiliation from the at least one trunking communication system to the at least one cellular communication system.

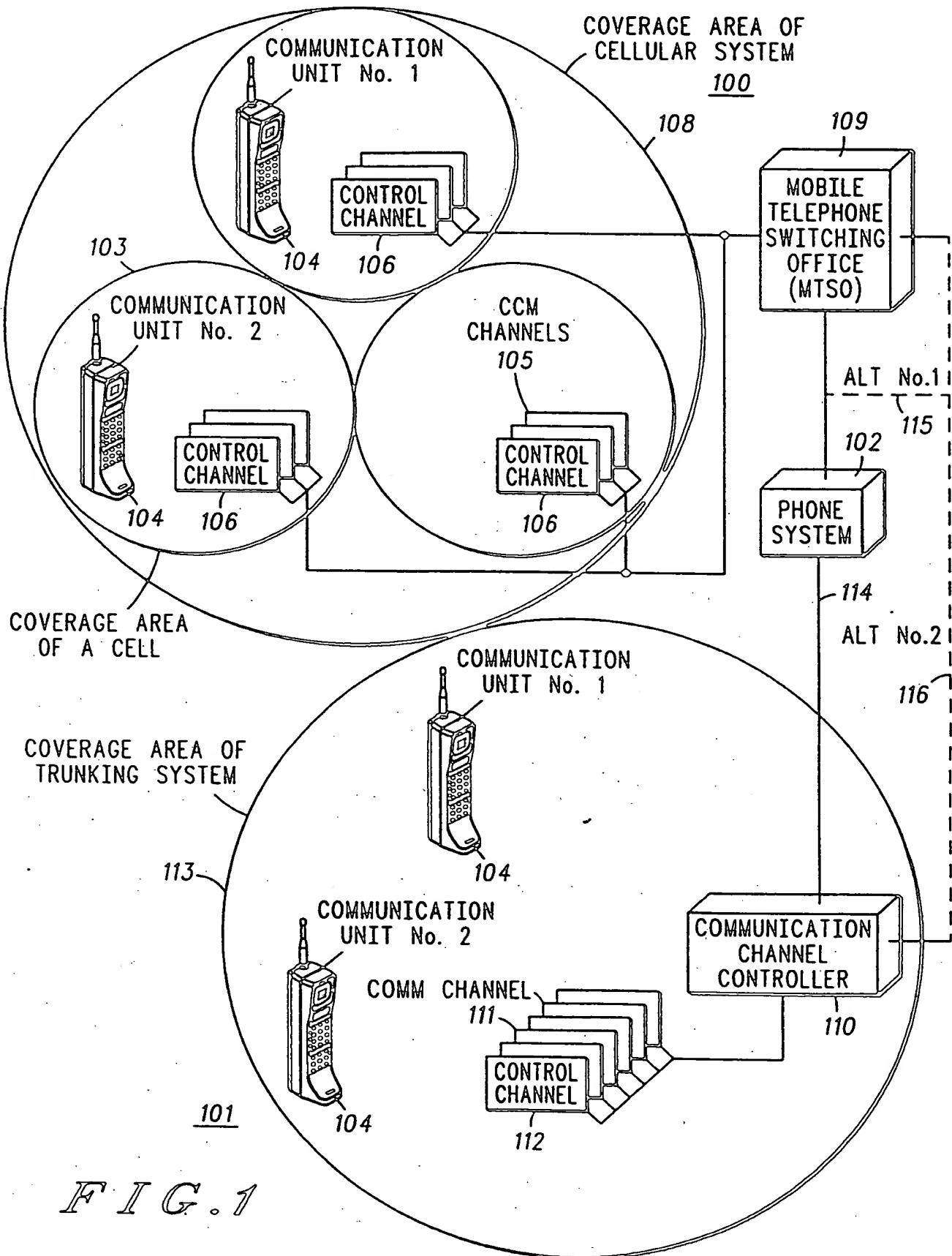
4. In a geographic region that contains at least one trunking communication system and at least one cellular communication system, wherein the at least one trunking communication system and the at least one cellular communication system have substantially overlapping coverage areas, wherein the at least one trunking communication system is operably coupled to the at least one cellular communication system, and wherein at least some of a plurality of data transmission units are affiliated with the at least one trunking communication system and are operable in either the at least one trunking communication system or the at least one cellular communication system, a method for communicating data between a data transmission unit of the at least some of the plurality of data transmission units and a data target, the method comprises the steps of:
- a) generating a data transmission request for the data transmission unit;
 - b) transferring affiliation of the data transmission unit from the at least one trunking communication system to the at least one cellular communication system when the data transmission request is processed;
 - c) transmitting a data packet via at least one control channel of the at least one cellular communication system; and
 - d) receiving the data packet by the data target via the at least one cellular communication system.

5. In the method of claim 4, step(a) further comprises generating, by the data transmission unit, the data transmission request.

6. In a geographic region that contains at least one trunking communication system and at least one cellular communication system, wherein the at least one trunking communication system and the at least one cellular communication system have substantially overlapping coverage areas, wherein the at least one trunking communication system is operably coupled to the at least one cellular communication system, and wherein at least some of a plurality of data transmission units are affiliated with the at least one trunking communication system and are operable in either the at least one trunking communication system or the at least one cellular communication system, a method for a communication channel controller of the at least one trunking communication system to control transmission of a data packet between a data transmission unit of the at least some of the plurality of data transmission units and a data target, the method comprises the steps of:
- a) transmitting a data transmission request to the data transmission unit, wherein the data transmission request instructs the data transmission unit to transfer affiliation from the at least one trunking communication system to the at least one cellular communication system and to transmit the data packet when the data transmission unit is affiliated with the at least one cellular communication system;
 - b) deciphering the data packet to identify the data target; and
 - c) instructing the data target to transfer its affiliation from the trunking communication system

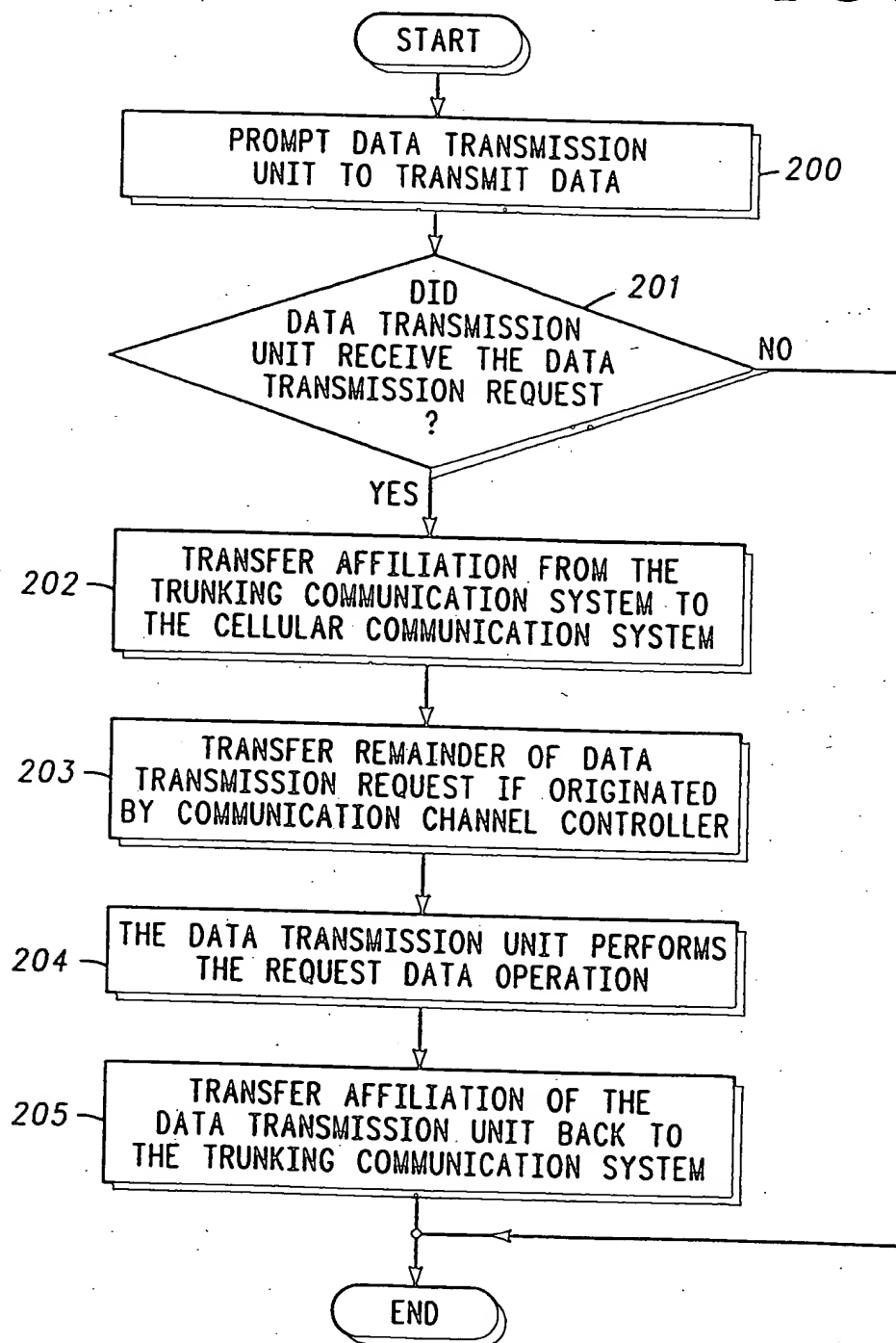
to the cellular communication system, such that it receives the data packet via the at least one cellular communication system.

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FIG. 2



INTERNATIONAL SEARCH REPORT

International Application No. PCT/US91/08002

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ⁶ According to International Patent Classification (IPC) or to both National Classification and IPC IPC(5): H04B 7/26 U.S. CL.: 455/33,56; 379/60														
II. FIELDS SEARCHED <div style="text-align: center; margin-top: 10px;">Minimum Documentation Searched ⁷</div> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 20%;">Classification System</th> <th style="width: 80%;">Classification Symbols</th> </tr> <tr> <td style="padding: 5px;">U.S. CL.</td> <td style="padding: 5px;">455/33,34,53,54,56,76,89 379/59,60,63</td> </tr> </table> <div style="text-align: center; margin-top: 10px;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸</div>			Classification System	Classification Symbols	U.S. CL.	455/33,34,53,54,56,76,89 379/59,60,63								
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U.S. CL.	455/33,34,53,54,56,76,89 379/59,60,63													
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹ <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">Category ¹⁰</th> <th style="width: 60%;">Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²</th> <th style="width: 30%;">Relevant to Claim No. ¹³</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">Y</td> <td style="padding: 5px;">US,A, 4,802,235 (TREATCH) 31 JANUARY 1989 See entire document</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1,2</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">A,P</td> <td style="padding: 5px;">US,A, 5,003,626 (NESS-COHN et al.) 26 MARCH 1991 See figures 3 and 4</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1-6</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">A,P</td> <td style="padding: 5px;">US,A, 5,058,199 (GRUBE) 15 OCTOBER 1991 See figures 1 and 2</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1-6</td> </tr> </tbody> </table>			Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³	Y	US,A, 4,802,235 (TREATCH) 31 JANUARY 1989 See entire document	1,2	A,P	US,A, 5,003,626 (NESS-COHN et al.) 26 MARCH 1991 See figures 3 and 4	1-6	A,P	US,A, 5,058,199 (GRUBE) 15 OCTOBER 1991 See figures 1 and 2	1-6
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<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>¹⁴ Special categories of cited documents: ¹⁵</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"A" document member of the same patent family</p> </div> </div>														
IV. CERTIFICATION <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px;"> Date of the Actual Completion of the International Search <div style="text-align: center; font-weight: bold; font-size: 1.2em;">28 JANUARY 1992</div> </td> <td style="width: 50%; padding: 5px;"> Date of Mailing of this International Search Report <div style="text-align: center; font-weight: bold; font-size: 1.2em;">09 MAR 1992</div> </td> </tr> <tr> <td style="width: 50%; padding: 5px;"> International Searching Authority <div style="text-align: center; font-weight: bold; font-size: 1.2em;">ISA/US</div> </td> <td style="width: 50%; padding: 5px;"> Signature of Authorized Officer <div style="text-align: center;"> <div style="text-align: center; font-weight: bold;">CHI PHAM</div> </div> </td> </tr> </table>			Date of the Actual Completion of the International Search <div style="text-align: center; font-weight: bold; font-size: 1.2em;">28 JANUARY 1992</div>	Date of Mailing of this International Search Report <div style="text-align: center; font-weight: bold; font-size: 1.2em;">09 MAR 1992</div>	International Searching Authority <div style="text-align: center; font-weight: bold; font-size: 1.2em;">ISA/US</div>	Signature of Authorized Officer <div style="text-align: center;"> <div style="text-align: center; font-weight: bold;">CHI PHAM</div> </div>								
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